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Changing practices of energy consumption: The influence of smart grid solutions in households

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Outline

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- Research questions and approach
- Empirical findings and discussion
- Conclusions and further perspectives

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Smart Grids Plus
ERA-Net

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RESEARCH QUESTION AND APPROACH

Background

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- The “smart grid” agenda
  - **Intermittent** renewable electricity production
  - **Balancing** production and consumption
  - **Flexible consumption** (demand response) and **micro-generation** increasingly in focus

Research question

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What are the implications of smart grid technologies in households for the everyday practices related to electricity consumption?

- How does the installation of **local electricity production** (microgeneration) influence **everyday practices**?
- What kind of influence does the **combination** of PVs with other "smart" energy technologies have on **everyday practices**?

*Particular focus on **temporality** of practices and consumption*

Theoretical approach

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- Practice theory
  - Focus on households' everyday practices
- Studies on prosumers and prosumption
  - Term originally coined by Alvin Toffler (1980)
  - Energy-making practices (Strengers, 2013)
  - Households *"live in very close proximity of their production units and take interest in how their devices operate, which changes the psychological distance and awareness of energy production* ***from 'plug and forget' to 'in sight and mind'"***. (Olkkonen et al.: 3-4)
  - Some evidence of households time-shifting electricity-consuming practices, but not conclusive

Empirical approach

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- Qualitative interviews with 13 households (20 interviewees in total)
  - PV + home battery: 3
  - PV + heat pump: 5
  - PV + electric vehicle: 4
  - PV alone: 1
- Interview themes
  - Everyday practices and consumption
  - Process and motivation
  - Experiences with trial / solutions
- Interviews recorded, transcribed and coded

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EMPIRICAL FINDINGS AND DISCUSSION

The importance of metering scheme

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Nearly all households (8 out of 10) on hourly net metering time-shift their consumption

- "Save money"
- Like the idea of using their "own" power
- Influence from trial setting?

None of three households on annual net metering scheme time shift consumption

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Jim Beck: Yes but, it is this mixture… It is about economy, but is also this satisfaction with saying… What we are doing know, its something we have produced our own power for… And what's weighting most, I don't really know… (…) We are not part of the old scheme [the annual net metering], so we have to use hour by hour… (…) what we are selling to the grid, we are getting so little for that it is the most logical to use it ourselves.

About time shifting consumption

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- Time shifted practices: Laundering and dishwashing

[Whether it is difficult / troublesome to time shift consumption?]

Irene: No, I don't think it is…

Jens: At first, it was [like]… (…) 'that's something we need to remember tomorrow', but now I think its just… 'Beep, beep, beep' [making the sound of setting the timer of the washing machine], should start in three hours… Or I can also load it before I'm leaving [for work]…

Irene: Yes, and then I'm hanging the laundry to dry [before Irene leaves home for work or in the afternoon when she arrives from work]…

Jens: And just make it so it starts after she has left [for work]…

Gender

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Among the interviewed…

- *If* a member of the household is regularly following the PV's power production and promotes time shifting of consumption, this is predominantly the male partner
- The female partner is most often the person who carries out the main share of the daily household chores – and also (relatively speaking) the person who most often has to time shift routines

Gender (example)

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[Whether the couple thinks about moving consumption in relation to sunshine?]

Jens: I do, at least… It's something I'm thinking about…
Irene: And then, you are rushing around in the home and…
Jens: No, I'm just making sure that if we are having some laundry, that it gets started…
Irene: And then it is me who have to get it started (laughing)…
And later:
Jens: If she is having something that needs to be ironed, then she might as well do it then… Everything that uses power, it should be when the sun is shining…
Interviewer (speaking to Irene): Are you doing it, then?
Irene: Sometimes, yes… (Laughs) Sometimes I just say 'okay, okay, boss'… Or 'okay, okay, darling'… But it is not something I'm devoted to, if I'm going to be honest…

Energy management practice?

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Karin: (…) in the evening I ask him about the dishwasher… If it is like we are getting too late in the evening – whether we should wait for the next day [with running the dishwasher] or… (…)

Emil: Also, we have one [mobile phone app] that looks at the weather report… So one can also get an opinion about, if it is cloudy weather today and then sunshine tomorrow… Then it can be worth it just to save it [the dishwashing] for tomorrow and then start when the sun is [shining]…

Energy management practice?

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Karin: When we have had our supper, then I ask him how it looks with the battery now, because otherwise I can wait to the next day with starting it [the dishwasher]… (…)

Emil: Then I just have a look how much there is on the battery, cause it goes all the way from zero to one hundred per cent.

Karin: If there's nothing on it, then it's not worthwhile turning it [the dishwasher] on. Then, you can wait [until the next day], as well.

EVs

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- All households with EVs are plugging in their car upon home arrival (typically late afternoon)
- Being prepared for unexpec-ted incidents (security)
- Lack of synchronization between PV power production and the timing of the EV recharging…

Batteries

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- Batteries appear to make it less attractive to move consumption in time (**redelegating** the balancing problem to the batteries)

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Emil: It has probably made it easier with the battery, because (…) then you know that when the sun is shining the entire day, then you know that your battery is charged one hundred per cent. And then, you can actually just start it [the dishwasher etc.] in the evening.

Batteries

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- Across all interviews: Several are "dreaming" about combining their PVs with a home battery – when batteries get cheaper
  - Economical independence (generating own power)
  - Self-sufficiency / independence (e.g. in cases of blackouts)
- Implications on a system level?

Bjarne: But it is sort of the vision, the dream… To get these batteries in the garage over there, and be completely independent of the power station, in fact… So when the big bang comes and everything fail, then we can just switch over to battery operation and heat a pot of water for a pot of coffee or tea…

Heat pumps

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- Widespread satisfaction with heat pumps (saving money and providing a good indoor comfort)
- In general no “interaction” with the heat pump (cf., e.g., PVs and EVs)
- A “silent” technology

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CONCLUSIONS AND FURTHER PERSPECTIVES

Influence of microgeneration?

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- PVs as “enabler” of active time shifting?
  - Support findings of Olkkonen et al. and others regarding how microgeneration seems to “invite” to (energy) engagement = “in sight and mind” > < widespread smart grid design ideal of invisibility and automation
  - More successful than Time of Use (ToU) pricing schemes?!
  - **But system challenges? And how to communicate that?**
- The importance of regulation
  - Annual vs. hourly net metering
- Gendering
  - Males seem more engaged in planning & management
- Distinct “energy management” practices?

Influence of PV+ combinations

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- The attractiveness of batteries (and self-sufficiency and system independency)
  - A future system challenge?
- Recharging EVs upon home arrival – a “serious” (grid) challenge?
- The “silent” heat pumps